THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/3

Paper 3

CHEMISTRY – (Practical)

Mar. 2022 – 2¼ hours

Name ..... Index Number .....

Candidate's Signature ..... Date .....

Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer **all** the questions in the spaces provided in the question paper.
(d) You are **not** allowed to start working with the apparatus for the first 15 minutes of the 2¼ hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.
(e) All working **must** be clearly shown where necessary.
(f) **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used.
(g) **This paper consists of 8 printed pages.**
(h) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(i) **Candidates should answer the questions in English.**

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	15	
2	8	
3	17	
Total Score	40	

1. You are provided with:

- **Solution A:** 0.10 M solution of a monobasic acid A;
- **Solution B:** Sodium hydroxide solution;
- **Solution C:** containing 10.0 g of acid C per litre of solution.

You are required to:

- Standardise **solution B** using **solution A**;
- Determine the number of moles of sodium hydroxide that react with one mole of acid C.

PROCEDURE I

Fill the burette with **solution A**. Using a pipette and pipette filler, place 25.0 cm³ of **solution B** into 250 ml conical flask. Titrate **solution B** with **solution A** using phenolphthalein indicator and record your results in **Table 1**. Repeat the titration and complete **Table 1**.

(a) **Table 1**

24.0

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution A used, cm³			

CT 1
D 1
A 1
PA 1
FA 1

(4 marks) 05

(b) Calculate the:

(i) average volume of **solution A** used. (1 mark)

Correct Working ½ Correct ans (b)(i) ½

(ii) number of moles of **solution A** in the average volume used. (1 mark)

$= \frac{\text{correct ans (b)(i)} \times 0.1}{1000}$ ½ = Correct ans (b)(ii) ½ I

(iii) number of moles of sodium hydroxide (N) in 25.0 cm³ of solution B. (1 mark)

Ratio A : N is 1:1 ½

∴ ans(b)(ii) ≡ ans(b)(iii) ½ I

(iv) concentration of sodium hydroxide in moles per litre. (1 mark)

$= \frac{1000 \times \text{ans (b)(iii)}}{25}$ ½ = ans(b)(iv) ½ I

PROCEDURE II

Clean the burette and fill it with **solution C**. Using a pipette and pipette filler, place 25.0 cm³ of **solution B** into a 250 ml conical flask.

Titrate **solution B** with **solution C** using phenolphthalein indicator and record your results in **Table 2** Repeat the titration and complete **Table 2**.

(c) **Table 2**

16.5

	I	II	III	
Final burette reading				
Initial burette reading				
Volume of solution C used, cm³				

CT1
D1
A1
PA1
FA1

(4 marks) 05

(d) Calculate the:

(i) average volume of **solution C** used. (1 mark)

Correct working ½ Correct ans (d)(i) ½ I

(ii) concentration in moles per litre, of **solution C**, given that the relative formula mass of **acid C** is 210.0. (1 mark)

= 10/210 ✓½ = 0.0476 ✓½ I

(iii) number of moles of **acid C** in the average volume used. (1 mark)

= $\frac{\text{Correct ans (d) (ii)} \times 0.0476}{1000}$ ✓½ = Correct ans (d)(iii) ✓½ I

(e) (i) Write the ratio of moles of **acid C** to moles of sodium hydroxide (N) in the 25.0 cm³ of **solution B**. (1 mark)

= ans (d)(iii) : ans (b)(iii) ✓1 I

(ii) Determine the number of moles of sodium hydroxide that react with one mole of **acid C**. (1 mark)

= $\frac{\text{ans (b)(iii)}}{\text{ans (d)(iii)}}$ ✓½ = ans (e)(ii) ✓½ I

* MUST BE A WHOLE NUMBER

2. You are provided with **solid D**.

You are required to determine the freezing point of **solid D**.

PROCEDURE

(i) Fill a 250 ml beaker with about 200 cm³ of tap water and heat the water until it boils.

(ii) Place all **solid D** provided in a **dry** test tube and insert a thermometer into the solid.

(iii) Place the test tube in the boiling water and allow the solid to heat until it all melts.

(iv) When the temperature of the melted solid is approximately 90 °C, remove the test tube, wipe the sides with tissue paper and then place the test tube into an empty 250 ml beaker

(v) Start the stop watch or clock when the temperature of the melted solid is 85.0 °C.

(vi) As the solid cools, measure and record its temperature every 30 seconds and complete **Table 3**.

(a) **Table 3**

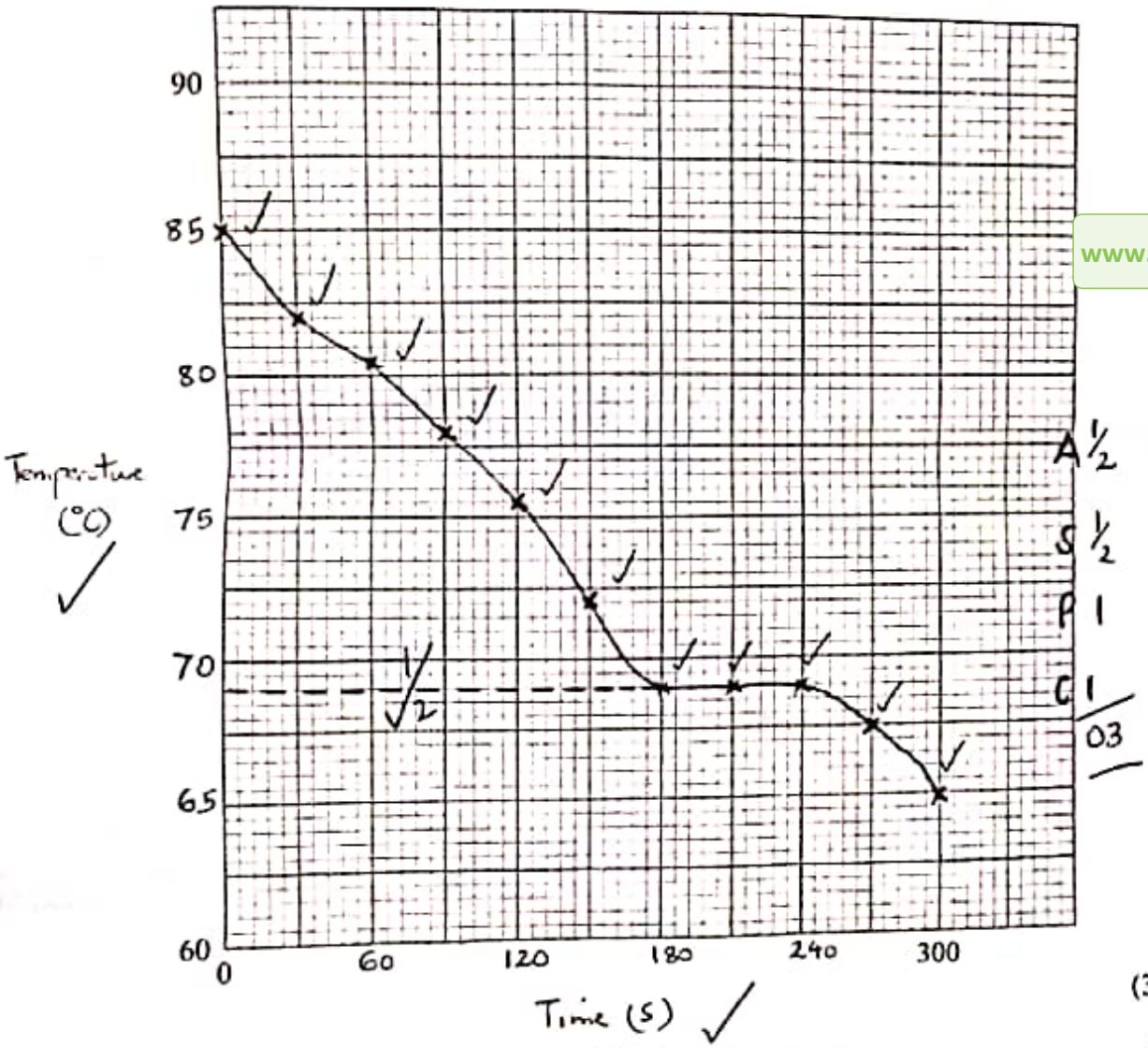
69.0

Time, s	0	30	60	90	120	150	180	210	240	270	300
Temperature, °C	85.0	82.0	80.5	78.0	75.5	72.0	69.0	69.0	69.0	67.5	65.0

CT1
D½
A½
TL
03

(3 marks)

(b) On the grid provided, plot a graph of temperature (vertical axis) against time.



A½
S½
P1
C1
03

(3 marks)

(c) Using the graph in (b), determine the freezing point of solid D. (1 mark)

Showing ½ Correct reading ½ I

3. You are provided with **solid E**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place **all** the **solid E** in a boiling tube. Add about 10 cm³ of dilute nitric(V) acid, warm the mixture and then allow to stand until all the solid dissolves. Add about 10 cm³ of distilled water to the solution and shake. Retain the solution for tests **(b)** and **(c)**.

Observations	Inferences
No effervescence ½	CO_3^{2-} / SO_3^{2-} ½ absent
E dissolves to form a blue solution ½	Cu^{2+} present ½

2

(1 marks) (1 mark)

(b) Use about 2 cm³ portions of the solution obtained in 3(a) for each of the following tests.

(i) To the **first portion** add 2 or 3 drops of aqueous barium nitrate.

Observations	Inferences
No white ppt formed 1	SO_4^{2-} absent 1

2

(1 mark) (1 mark)

(ii) To the **second portion** add 2 or 3 drops of aqueous lead(II) nitrate.

Observations	Inferences
No yellow ppt formed ½	I^- absent ½
No white ppt formed ½	Cl^- / Br^- absent ½

2

(1 mark) (1 mark)

(iii) To the **third portion** add aqueous sodium hydroxide dropwise until in excess

Observations	Inferences
Blue ppt ½ formed insoluble ½ in excess	Cu^{2+} present ✓1

2

(1 mark) (1 mark)

(iv) Place about 3 cm^3 of aqueous ammonia in a test tube. To the **fourth portion**, add all the aqueous ammonia from the test tube dropwise.

Observations	Inferences
Blue ppt ½ formed that dissolves in excess to form a deep blue solution ½	Cu^{2+} present ✓1

2

(1 mark) (1 mark)

(c) To the remaining solution of **solid E** in the boiling tube, add all the **solid G** provided. Shake the mixture for about 2 minutes. Filter the mixture into a boiling tube. Retain the filtrate for tests (i) and (ii) below.

Observations	Inferences
Blue solution changes to green ✓	Cu^{2+} displaced by G / G is more reactive than Cu / G is oxidized ✓1
Brown residue ✓	by Cu^{2+} / Cu^{2+} are reduced by G /
Green filtrate ✓	Cu^{2+} are displaced by Fe

2

Boiling tube becomes warm ✓ (1 mark)

½ mk @ to a max. of 1mk

(i) To about 2 cm^3 portion of the filtrate, add aqueous ammonia dropwise until in excess.

Observations	Inferences
Green ppt formed insoluble in excess	Fe^{2+}

(1 mark) (1 mark)

2

(ii) To about 2 cm^3 portion of the filtrate add 2 or 3 drops of dilute hydrogen peroxide solution.

Observations	Inferences
Green solution changes to brown yellow	Fe^{2+} oxidized to Fe^{3+}
	Fe^{3+} formed
Effervescence	

(1 mark) (1 mark)

2

Rej. turn